

What is claimed is:

1. A plunger pump housing with offset access bore, the plunger pump housing comprising:
  - a suction valve bore having a portion with substantially circular transverse cross-sections for accommodating a circular suction valve, a transition area for facilitating bore interfaces, and a first centerline;
  - a discharge valve bore having a portion with substantially circular transverse cross-sections for accommodating a circular discharge valve, transition area for facilitating bore interfaces, and a second centerline, said first and second centerlines being colinear;
  - a plunger bore having a proximal packing area, a distal transition area for facilitating bore interfaces, and a central area between said packing area and said transition area, said central area having a substantially circular transverse cross-section with a central area diameter and a third centerline, said third centerline being coplanar with said first and second centerlines; and
  - an offset access bore having a cylindrical portion for accommodating an access bore plug and a transition area for facilitating bore interfaces, said cylindrical portion having a fourth centerline, said fourth centerline being coplanar with said first, second and third centerlines and parallel to said third centerline, and said fourth centerline being spaced a predetermined distance apart from said third centerline toward said suction valve bore;
- wherein said suction valve bore transition area has elongated transverse cross-sections substantially perpendicular to said first centerline and with a long axis substantially perpendicular to a plane containing said first, second, third and fourth centerlines;
- wherein said discharge valve bore transition area has elongated transverse cross-sections substantially perpendicular to said second centerline and with a long axis substantially perpendicular to a plane containing said first, second, third and fourth centerlines;
- wherein said plunger bore transition area has elongated transverse cross-sections substantially perpendicular to said third centerline and with a long axis substantially perpendicular to a plane containing said first, second, third and fourth centerlines; and

wherein said offset access bore cylindrical portion and said offset access bore transition area have elongated transverse cross-sections substantially perpendicular to said fourth centerline, each said elongated access bore cross-section having a long axis substantially perpendicular to a plane containing said first, second, third and fourth centerlines.

2. The plunger pump housing of claim 1 wherein said second and third centerlines form an angle within a range from approximately 85 degrees to approximately 95 degrees.

3. The plunger pump housing of claim 1 wherein said predetermined distance is between about 2% and about 20% of said central area diameter.

4. The plunger pump housing of claim 1 wherein said plunger bore proximal packing area comprises a tapered portion for accommodating a corresponding tapered cartridge packing assembly.

5. The plunger pump housing of claim 1 wherein each said bore transition area has at least one adjacent chamfer for smoothing bore interfaces.

6. An access bore plug for a plunger pump housing having an offset access bore, the access bore plug comprising

a flange for securing said access bore plug to said plunger pump housing, said flange having a longitudinal axis;

a cylindrical portion extending longitudinally from said flange, said cylindrical portion having an elongated transverse cross-section, said cylindrical portion extending longitudinally from said flange sufficiently to slidingly and sealingly fit within a corresponding offset access bore cylindrical portion in said plunger pump housing, said elongated transverse cross-section having a major axis and a perpendicular minor axis;

seal means on said cylindrical portion for providing said sliding and sealing fit of said cylindrical portion within said corresponding offset access bore cylindrical portion in said plunger pump housing;

14 at least one suction valve spring retainer support arm extending longitudinally from said  
15 cylindrical portion of said access bore plug for securing a suction valve spring  
16 retainer mounting bracket in a position aligned with a perpendicular to said  
17 minor axis, said perpendicular being parallel to said longitudinal axis and said  
18 suction valve spring retainer mounting bracket being spaced apart from said  
19 cylindrical portion of said access bore plug, said mounting bracket position being  
20 substantially centrally located over a suction bore transition area in the plunger  
21 pump housing; and  
22 a longitudinal slot in said suction valve spring retainer mounting bracket for slidingly  
23 engaging a suction valve spring retainer;  
24 wherein said suction valve spring retainer mounting bracket and each said suction valve spring  
25 retainer support arm comprises an inner surface, each said inner surface generally  
26 conforming to a cylindrical envelope and slightly spaced apart from said cylindrical  
27 envelope, said cylindrical envelope encompassing that space that would be cyclically  
28 occupied by a plunger's pumping movement in a plunger bore of said plunger pump  
29 housing in which said access bore plug may be secured.

1 7. The access bore plug of claim 6 comprising a single suction valve spring retainer support  
2 arm.

1 8. The access bore plug of claim 6 comprising paired suction valve spring retainer support  
2 arms.

1 9. The access bore plug of claim 7 wherein said single suction valve spring retainer support  
2 arm is dimensioned to minimize unswept volume in said plunger pump housing.

1 10. The access bore plug of claim 8 wherein said paired suction valve spring retainer support  
2 arms are dimensioned to minimize unswept volume in said plunger pump housing.

1 11. A plunger pump housing with offset access bore, the plunger pump housing comprising:  
2 a suction valve bore having a portion with substantially circular transverse cross-sections  
3 for accommodating a circular suction valve, a transition area for facilitating bore  
4 interfaces, and a first centerline;  
5 a discharge valve bore having a portion with substantially circular transverse cross-  
6 sections for accommodating a circular discharge valve, a transition area for  
7 facilitating bore interfaces, and a second centerline, said first and second  
8 centerlines being colinear;  
9 a plunger bore having a proximal packing area, a distal transition area for facilitating bore  
10 interfaces, and a central area between said packing area and said transition area,  
11 said central area having a substantially circular transverse cross-section with a  
12 central area diameter and a third centerline, said third centerline being coplanar  
13 with said first and second centerlines; and  
14 an offset access bore having a cylindrical portion for accommodating the access bore plug  
15 of claim 6 and a transition area for facilitating bore interfaces, said cylindrical  
16 portion having a fourth centerline, said fourth centerline being coplanar with said  
17 first, second and third centerlines and parallel to said third centerline, and said  
18 fourth centerline further being spaced a predetermined distance apart from said  
19 third centerline toward said suction valve bore;  
20 wherein said suction valve bore transition area has elongated transverse cross-sections  
21 substantially perpendicular to said first centerline and with a long axis substantially  
22 perpendicular to a plane containing said first, second, third and fourth centerlines;  
23 wherein said discharge valve bore transition area has elongated transverse cross-sections  
24 substantially perpendicular to said second centerline and with a long axis substantially  
25 perpendicular to a plane containing said first, second, third and fourth centerlines;  
26 wherein said plunger bore transition area has elongated transverse cross-sections substantially  
27 perpendicular to said third centerline and with a long axis substantially perpendicular to  
28 a plane containing said first, second, third and fourth centerlines;  
29 wherein said offset access bore cylindrical portion and said offset access bore transition area have  
30 elongated transverse cross-sections substantially perpendicular to said fourth centerline,

each said elongated access bore cross-section having a long axis substantially perpendicular to a plane containing said first, second, third and fourth centerlines.

12. The plunger pump housing of claim 11 wherein said second and third centerlines form an angle within a range from approximately 85 degrees to approximately 95 degrees.

13. The plunger pump housing of claim 11 wherein said predetermined distance is between about 2% and about 20% of said central area diameter .

14. The plunger pump housing of claim 11 wherein said plunger bore proximal packing area comprises a tapered portion for accommodating a corresponding tapered cartridge packing assembly.

15. The plunger pump housing of claim 11 wherein each said bore transition area has at least one adjacent chamfer for smoothing bore interfaces.

16. A plunger pump housing with offset access bore, the plunger pump housing comprising:  
a suction valve bore having a portion with substantially circular transverse cross-sections for accommodating a circular suction valve, a transition area for facilitating bore interfaces, and a first centerline;  
a discharge valve bore having a portion with substantially circular transverse cross-sections for accommodating a circular discharge valve, a transition area for facilitating bore interfaces, and a second centerline, said first and second centerlines being colinear;  
a plunger bore having a proximal packing area, a distal transition area for facilitating bore interfaces, and a central area between said packing area and said transition area, said central area having a substantially circular transverse cross-section with a central area diameter and a third centerline, said third centerline being coplanar with said first and second centerlines; and  
an offset access bore having a cylindrical portion for accommodating an access bore plug and a transition area for facilitating bore interfaces, said cylindrical portion having

16 a fourth centerline, said fourth centerline being coplanar with said first, second  
17 and third centerlines and parallel to said third centerline, and said fourth centerline  
18 being spaced a predetermined distance apart from said third centerline toward said  
19 suction valve bore;  
20 wherein said suction valve bore transition area has elongated transverse cross-sections  
21 substantially perpendicular to said first centerline and with a long axis substantially  
22 perpendicular to a plane containing said first, second, third and fourth centerlines;  
23 wherein said discharge valve bore transition area has elongated transverse cross-sections  
24 substantially perpendicular to said second centerline and with a long axis substantially  
25 perpendicular to a plane containing said first, second, third and fourth centerlines;  
26 wherein said plunger bore transition area has elongated transverse cross-sections substantially  
27 perpendicular to said third centerline and with a long axis substantially perpendicular to  
28 a plane containing said first, second, third and fourth centerlines;  
29 wherein said offset access bore cylindrical portion and said offset access bore transition area have  
30 elongated transverse cross-sections substantially perpendicular to said fourth centerline,  
31 each said elongated access bore cross-section having a long axis substantially  
32 perpendicular to a plane containing said first, second, third and fourth centerlines;  
33 wherein each said bore transition area has at least one adjacent chamfer for smoothing bore  
34 interfaces; and  
35 wherein at least one chamfer radius measured perpendicular to said first centerline exceeds all  
36 chamfer radii measured perpendicular to said third centerline.

1 17. The plunger pump housing of claim 16 wherein said second and third centerlines form an  
2 angle within a range from approximately 85 degrees to approximately 95 degrees.

1 18. The plunger pump housing of claim 16 wherein said predetermined distance is between  
2 about 2% and about 20% of said central area diameter .

1 19. The plunger pump housing of claim 16 wherein said plunger bore proximal packing area  
2 comprises a tapered portion for accommodating a corresponding tapered cartridge packing  
3 assembly.

1 20. A method of retaining a suction valve spring in a right-angular plunger pump housing  
2 with offset access bore, the method comprising  
3 compressing said suction valve spring by pressure exerted on a suction valve spring  
4 retainer coupled to said spring;  
5 inserting the access bore plug of claim 6 in said offset access bore of said plunger pump  
6 housing to position its suction valve spring retainer mounting bracket substantially  
7 centrally over said plunger pump housing's suction bore transition area;  
8 slidably engaging said suction valve spring retainer in said suction valve spring retainer  
9 mounting bracket's longitudinal slot simultaneously with said inserting step;  
10 releasing pressure exerted on said suction valve spring in said compressing step to allow  
11 said spring retainer to contact said suction valve spring retainer mounting bracket;  
12 and  
13 securing said access bore plug in said plunger pump housing with a threaded bore plug  
14 retainer to retain said suction valve spring in said plunger pump housing.  
15